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APPARATUS FOR THE SEPARATION OF AT LEAST ONE
CONSTITUENT OF A GAS MIXTURE BY PRESSURE SWING
ADSORPTION

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The present invention relates to apparatus for separating at least one component of a gas mixture by pressure swing adsorption of the type called "PSA" or "VSA", comprising, in a generally vertical vessel
10 comprising an upper dome, at least one adsorbent mass separating a first vertical chamber receiving the gas mixture to be separated, from a second vertical chamber collecting a separated gas mixture, a generally horizontal flexible wall being pressed against the
15 upper end of the adsorbent mass by pressing means.

An apparatus of this type is described in document US-A-5 176 721 (Hay/Vigor), in the name of the Applicant. In this type of apparatus, in which the gases flow
20 horizontally, the packing membrane separates an upper volume at substantially constant pressure from lower volumes which are alternately subject to sometimes significant pressure variations. This generates a fatigue load on the structural parts of the apparatus
25 (in practice: weld-fabricated metal parts such as grilles, sheets, plates, shells, tubes, ends) which require oversizing (thickness, weld classes, accuracy of adjustments) considerably increasing the manufacturing and installation costs.

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The object of the present invention to propose design of apparatus that not only allows the manufacturing and assembly costs to be reduced, but also allows the existing sets of apparatus to be reconditioned in order
35 to significantly lengthen their operational life.

For this purpose, according to one feature of the invention, the apparatus comprises means for controlling the pressure in the volume between the flexible wall and the dome.

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According to more particular features of the invention:

- the upper volume between the flexible wall and the dome communicates with one of said first and second chambers,
- 10 - the apparatus further comprises means for ballasting the flexible wall,
- the apparatus comprises a line connecting the upper volume to the second chamber,
- the apparatus comprises a passage between the volume
15 and the first chamber,
- the adsorbent mass is annular, and the first and second chambers are concentric.

With the arrangement according to the invention, the
20 pressure in the upper volume is no longer constant but is controlled as a function of the process pressures in the adsorbent, typically balanced with one of the operating pressures upstream or downstream of the adsorbent, thereby substantially eliminating the
25 undesirable loads hitherto transmitted by the flexible wall to the rest of the structure of the apparatus.

Furthermore, the line or the communicating passage can be arranged without any substantial change in the
30 existing apparatus architectures.

Other features and advantages of the present invention will appear from the following description of embodiments, provided for illustration but in no way

limiting, with reference to the appended drawings, in which:

- figure 1 shows a vertical section of a first embodiment of an apparatus according to the invention; and
- figure 2 shows a partial vertical section of a second embodiment of an apparatus according to the invention.

10 The embodiment shown in figure 1 shows a radial adsorber with, in a cylindrical vessel 1 with a vertical axis comprising an upper dome 2 and a bottom end 3, at least one annular adsorbent mass 4, coaxial with the axis of the vessel 1, by a lower chamber 5
15 formed by a perforated central tube 6 coaxial with the axis of the vessel 1, from a peripheral chamber 7 communicating with the lower volume of the vessel 1 from which, in the production phase, issues an outlet line 8 for the production gas mixture separated from a
20 feed gas mixture introduced via the lower end of the central tube 6. In the regeneration phase, the adsorbent mass 4 is flushed by a gas mixture escaping with reduced pressure, via the same lower end of the central tube 6. The adsorbent is maintained externally
25 and separated from the peripheral chamber 7 by at least one perforated shell 15 coaxial with the axis of the vessel 1.

In a manner known per se, an impermeable flexible wall or membrane 9 extends horizontally in the vessel 1 to
30 cover the upper ends of the annular chamber 7, of the annular adsorbent mass 4, and of the central tube 5.

In the embodiment shown, the membrane 9 is covered with
35 at least one bed 10 of individual or particulate

elements forming a ballast, such as metal, glass or ceramic beads, and the upper part of the volume between the dome 2 and the membrane 9 is occupied by a skin 11 communicating, via an external line 12 passing through the dome 2, with the production gas line 8. The line comprises a solenoid valve 14 for adjusting the pressure in the dome 2 as a function of the process parameters. In this embodiment, the pressure on the upper part of the membrane 9 substantially "follows" the pressure of the production gas mixture while simultaneously, at any time in the cycle, remaining not lower than the maximum process gauge pressure in the adsorbent 4.

As a variant, the line 12 may simply terminate in the top of the dome 2 to directly pressurize the upper volume above the membrane 9, most of this internal volume being occupied by particulate materials of lower density than the particulate materials ballasting the membrane 9 and superposed thereon.

In the embodiment in figure 2, the volume above the membrane 9 communicates permanently, via at least one calibrated passage 13, with the internal chamber 5 and thereby "follows" the pressure in this internal chamber 5.

The present invention is ideal for apparatus for separating components of air, particularly for supplying oxygen more than 90% pure. In this case, the adsorbent 4 contains at least one zeolite, advantageously of the LSX type, advantageously an LiLSX zeolite, the membrane 9 being made from the material marketed under the name "Hypalon" and/or from neoprene:

Although the invention has been described with reference to particular embodiments, it is not limited thereto but is suitable for modifications and variants that will appear to a person skilled in the art in the
5 context of the claims below.